1253271

PATENT SPECIFICATION

(11) 1253271

DRAWINGS ATTACHED

(21) Application No. 2711/69 (22) Filed 16 Jan. 1969

(45) Complete Specification published 10 Nov. 1971

(51) International Classification A 23 l 1/32 // A 23 j 3/00

(52) Index at acceptance A2B 1A 1C 1L

(72) Inventors DANIEL MELNICK, MARCUS I. WEGNER and DAVID R. DAVIES

(54) REFATTED EGG YOLK SOLIDS, PROCESS FOR PREPARING THE SAME, AND FOOD PRODUCTS COMPRISING THE SAME

(71) We, CORN PRODUCTS COMPANY, a Corporation organized under the laws of the State of Delaware, United States of America, of International Plaza, Englewood Cliffs, New Jersey, United States of America, do hereby declare the invention, for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to novel food products based on dry egg yolk solids and to process for making them.

More specifically, the present invention provides a particulate, substantially dry refatted egg yolk solids product comprising an intimate admixture: undenatured egg yolk solids from which at least 50% of the native egg yolk original fat and cholesterol has been removed, but replaced with an edible vegetable oil in an amount from 10 to 70% by weight of the refatted egg yolk solids.

This invention also provides a conveniently packaged egg combination food product for mixture and rehydration to form a consumable, egg product upon cooking. The packaged egg combination food product comprises the dry egg yolk solids product mentioned above, which is easily rehydratable, and which is in small particulate size packaged in a first moisture-proof, sealed package and a food of gross particulate size, in microbiologically and organoleptically stabilized form, requiring no further hydration, packaged in a second moisture-proof, sealed package. The proportions in each of the moisture-proof, sealed packages are compatible to permit their use together in preparing a composition, ready for cooking, by rehydrating the egg material and mixing with the food of gross particulate size.

The present invention also provides a process for preparing refatted egg yolk solids from which a portion of the original fat has been removed, comprising: forming an emulsion of the oil-in-water type from a mixture comprising an edible vegetable oil, the partially defatted and dehydrated undenatured egg yolk solids from which at least 50% of the original fat has been removed and water but replaced with an edible vegetable oil in an amount from 10 to 70% by weight of the defatted egg yolk solids; subjecting the emulsion to a drying process, and recovering substantially dry refatted egg yolk solids.

It has long been recognised that eggs are a most desirable food in contributing to the nutritional requirements of man. Eggs are a remarkable biological product, as evidenced by their many important functions, including binding, clarifying, extending, leavening, thickening, and emulsifying in food products. Eggs are further used in many areas of cookery for enhancing and improving such quality indices as color, texture, flavor and nutrition.

The liquid portion of whole eggs consists of about 64% white and 36% yolk. The egg white or egg albumen is essentially an aqueous solution of proteins containing small amounts of other materials such as minerals and sugars, and only a trace of fat. The egg yolk, on the other hand, contains virtually all of the fat and cholesterol of whole eggs. These latter compounds are present in combination with egg yolk proteins, as complex lipo-protein compounds. Consequently, many of the functions and nutritional aspects of the egg reside specifically in the yolk portion. This is evidenced by the incorporation of the yolk alone, as an ingredient in many basic food formulations.

In the past few years, much emphasis has been placed on the desirability of reducing the amount of the more saturated fats and replacing them with polyunsaturated fats in the that high serum cholesterol content may be human diet. Recent medical evidence indicates linked to diseases of the vascular system. The evidence further shows that dietary cholesterol from egg yolks is more effective in raising serum cholesterol levels than an equivalent

amount of cholesterol incorporated as such in the diet. It is for this reason that many physicians and nutritionists frequently limit the quantities of eggs to be consumed by patients showing a tendency toward high serum cholesterol levels.

The modification or alteration of eggs to substantially increase the polyunsaturated fat to saturated fat ratio and to significantly decrease the cholesterol content would allow persons who choose to control their serum cholesterol content through dietary changes to continue to enjoy the nutritional benefits of the egg, without any loss of the desirable functional and organoleptic qualities of natural eggs. Heretofore, no satisfactory product has been developed.

Moreover, dry egg solids and many products which contain them, tend to have poor flavor as produced and poor flavor stability upon storage for long periods of time. For this reason, there has never been a dry egg product suitable for the preparation of scrambled eggs or of omelets of adequate flavor acceptability.

One recent approach by others to the problem involved decreasing the saturated fat content and increasing the polyunsaturated fat content of egg yolks through changing the diet of the hens. Although the fatty acid composition of the yolk is indeed, markedly influenced by the type of fat in the diet of the hens, the cholesterol content of the yolk has been found to be essentially independent of the type of fat used in the diet of the hens. In fact, the cholesterol level of the egg york may increase as the degree of unsaturation of the dietary fat increases. Such eggs are no improvement over conventional eggs in controlling the serum cholesterol level.

Another approach to the problem involved providing the consumer with an egg-like product, free of cholesterol, through the inclusion in the formulation of an imitation "yolk" which contains no natural yolk material at all, but is fabricated from vegetable sources. This product, after hydration and frying, is very different from scrambled eggs in odor, texture, and taste and has been found to be unacceptable to many users.

It appeared that the problem might be approached by refatting defatted egg yolk of a special type. Since all of the cholesterol and substantially all of the fat in the egg is in the egg yolk, only that portion of the egg need be modified.

In still another embodiment, the invention provides a conveniently packaged egg combination food product for mixture and rehydration to form a consumable egg combination food, upon cooking. More particularly, this embodiment of the invention provides a conveniently packaged egg product combination in unit or multi-unit consumption form, wherein the food products are packed in two moisture-proof packages, one containing the dry, easily rehydratable egg material of small particulate size, and the other containing gross particulate food material in microbiologically and organoleptically stabilized form requiring no further hydration and hence in ready-to-eat form. The amounts in the two packages are such that they can be used together in preparing a composition ready for cooking, by rehydrating the egg material, then mixing with the contents of the other package.

Instant food products have become increasingly popular in recent years. Quick cooking products have also become popular and frequently the two terms "quick cooking" and "instant" will refer to products requiring approximately the same amount of cooking time.

Probably of all foods in the home, those of minimal convenience are the egg product combinations eaten usually at breakfast time. In the first place, time is limited at breakfast, particularly prior to the start of a working day. Secondly, the preparation, especially of the adjuncts, are laborious and time consuming. By adjuncts is meant fried bacon strips, chopped ham and chopped mixed vegetables. The lack of convenience has been responsible to a significant degree for the falling per capita consumption of eggs.

Thus, an egg product combination, which would permit the preparation in a matter of a few minutes of products which look like and taste like bacon and eggs, ham and eggs, a Western omelette, sausages and eggs, would be a desirable high convenience food. If these products were also nutritionally superior, in being substantially free of cholesterol and in providing fat with a ratio of polyunsaturated to saturated fatty acids of at least 1.0, then they would also satisfy the needs of many persons.

Many instant food products, including those involving egg combinations such as dehydrated ham and eggs, and dehydrated vegetables and eggs, have failed on the consumer market because the organoleptic qualities of these food combinations, after a very short or instantaneous hydration and cooking period, were unsatisfactory. These products were hardly convenience foods because of the time required to hydrate the gross food particles; nutrionally they were no better than their conventional counterparts.

One advantage of the present invention is that useful egg food products and practical processes for making them are provided.

Another advantage of the invention is that the new egg food products and foods based upon them are characterized by superior flavor stability.

A further advantage of the present invention is that the egg product is quickly and economically prepared for eating.

It is another advantage of the present in-

vention that the cooked egg product is superior in flavour and at least equal in texture to those products made with conventional dried egg solids and at least equal in flavour and in texture to those made with fresh eggs.

A more specific advantage of the invention is that the egg yolk product is high in polyunsaturates, low in saturates, and low in cholesterol content.

It is another advantage of the present invention that a practical process for manufacture of egg products is provided wherein most of the animal fat and cholesterol have been replaced with a vegetable oil free of cholesterol.

Still another advantage of the present invention is that a simple process is provided for preparing an egg product wherein most of the animal fat and cholesterol have been replaced with a polyunsaturated vegetable oil free of cholesterol.

A more specific advantage of the present invention is that a dry mix is provided wherein most of the animal fat and cholesterol have been replaced by a vegetable oil, said product being particularly suitable for use in preparing scrambled eggs, or omelets, or a variety of foods in which whole fresh eggs are conventionally used.

It is also an advantage that the present invention provides a conveniently packaged egg combination food product, in unit or multi-unit consumption form.

It is yet another advantage of the present invention that the conveniently packaged egg combination food product is of the "instant" type, for mixture and rehydration to form a composition that can be cooked at once and eaten.

Another advantage of the invention is that the convenient package of an egg-based food product can be stored for months on end at room temperature without deterioration. A related advantage is that the convenient food package of the character described can be made up easily and quickly into a wide variety of egg dishes.

A further advantage of the invention is that there is provided a convenient package of separate containers of components of the "instant" type, that can be made up into egg-based food dishes easily and quickly, and that are in stable, storable, and easily handled form.

Yet another advantage of the invention is that there is provided convenience packages of the character described, wherein the egg-based food dishes are highly nutritious.

Still another advantage of the invention is that the components of the "instant" type can be made up easily and quickly into highly nutritious, egg-based dishes, and are packaged conveniently in a light-weight, flexible package that can be stored for long periods of time at ambient temperatures without deterioration, and can be easily handled.

It is a further advantage of the present invention that the convenience package of an egg-based combination food product of the "instant" type can be easily and quickly made up to form a flavorful, cooked, food product, the package being moisture-proof, and the packaged components being stable against both microbiological and flavor deterioration.

Other advantages of the present invention will be apparent hereinafter from the specification and from the recitals of the appended claims.

THE REFATTED EGG YOLK SOLIDS

No one heretofore has ever replaced the natural egg fat in egg products with a vegetable oil. Since the natural lipid-protein relationship in the egg is poorly understood, it is not surprising that others never thought to make, much less succeeded in making, such a replacement.

Polyunsaturated vegetable oils contain no cholesteral and therefore such oils are ideal replacements for the egg fat. As indicated in Table I, the yolk portion of the egg contains low levels of polyunsaturated fatty acids, moderately high levels of saturates, and an unusually high amount of cholesterol. In contrast, corn oil is high in polyunsaturates, low in saturates, and is free of cholesterol.

TABLE I

Composition of Egg Yolk Fat and Corn Oil

	Natural Egg Yolk	Corn Oil
Fatty Acid Composition		
Saturated Fatty Acids, %	34.0—36.0	11.5—13.5
Monounsaturated Fatty Acids, %	51.0—52.0	26.0—30.0
Polyunsaturated Fatty Acids, %	7.0—14.0	53.0—56.0
Polyunsaturated/saturated ratio	0.2—0.8	4.5—4.8
Cholesterol Content, mg.%	3700—7700	0

In practicing the present invention, it is preferable to use defatted egg yolk which will accept the polyunsaturated vegetable oil in such a manner as to re-establish the original *in situ* relationship between egg yolk fat and egg yolk protein. The latter relationship is so poorly understood that duplication of it through replacement of egg fat with polyunsaturated vegetable oil has hitherto never been contemplated or tried.

The desired egg yolk solids which are the object of the present invention must not only have had a major part of the original egg fat replaced by polyunsaturated vegetable oil, but must also possess the following attributes under conditions of use:

1. Dry mixes made with the refatted yolk solids must be readily dispersible (wetted) in water, preferably forming an emulsion.
2. The egg yolk protein in the rehydrated products made with the refatted yolk solids must retain the functional characteristics of coagulating in the presence of heat without any "coiling off", "watering out", or adverse texture changes being noted in the products.
3. The flavor of products made from refatted yolk solids must be at least equivalent to those products made with conventionally dried yolk solids and preferable equivalent to those made with fresh egg yolk.

An obvious method of attempting to add back the necessary polyunsaturated vegetable oil is to mix physically the oil with the defatted yolk solids. A product of this type, however, is found to be not readily dispersible in water, since the yolk solids are coated with fat, and furthermore, such products do not readily form an emulsion. Thus, this method is not acceptable. It was apparent that the original *in situ* relationship, as it existed between egg fat and egg yolk protein, had to be recreated following the add back of the polyunsaturated vegetable oil.

We discovered that the original *in situ* relationship between fat and protein in egg yolk could be attained by homogenizing a crude mixture of vegetable oil and an aqueous dispersion of defatted egg yolk solids. Emulsifiers are preferably added in this operation. The emulsion is then pasteurized and dried in such a way that the oil is encapsulated within an envelope of dehydrated egg yolk protein. This provides a readily dispersible refatted yolk material. These refatted yolk solids are high in polyunsaturates, low in saturates when a vegetable seed oil is used, and low in cholesterol content, yet retain all the desirable nutritional and physical attributes of egg yolk solids.

Surprisingly, the refatted yolk solids of the present invention were found to have a much better flavor than the original yolk solids. All traces of the objectionable strong egg flavor characteristic of dried egg yolk had been removed so that the delicate natural egg flavor associated with freshness is now detected. Flavor stability is extraordinary. Samples retain organoleptic acceptability after one year of storage at room temperature. Furthermore, no residual solvents can be found in the products of our invention. In contrast, conventional dry egg yolk products have objectionable odor and flavor even as freshly produced when used to make scrambled eggs.

The present invention provides a process for preparing edible refatted egg yolk solids utilizing conventional egg yolk solids from which a portion of the original fat has been removed. The defatted egg yolk solids are mixed with water and an edible vegetable oil. The mixture is then formed into an emulsion of the oil-in-water type and the emulsion is subsequently pasteurized, if necessary, and then subjected to a fast drying process. Substantially dry, particulate, refatted egg yolk solids are recovered.

The resultant substantially dry, particulate refatted egg yolk solids comprise an intimate mixture of egg yolk solids from which a substantial portion of the original fat has been removed and an edible vegetable seed oil that replaces all or at least a portion of the removed fat. These refatted solids have substantially all of the desirable functional properties of the original egg yolk solids. These functional properties which manifest upon reconstitution include emulsifying, extending, leavening, thickening, and binding characteristics as well as the ability to coagulate upon heating without "oiling off", "watering out", or exhibiting adverse texture characteristics. The dry, refatted egg yolk solids may be combined with dry egg white solids to yield a dry whole egg product having many of the characteristics of conventionally powdered whole eggs but superior flavor, storage stability, and other properties as will be described further presently.

In order to make a final product that is exceptionally palatable, of good appearance, and that can be produced by practical continuous techniques, several ingredients are incorporated in the mixture which is emulsified and subsequently dried. These ingredients will now be described in detail, and the process for making the emulsion will be described. In this description, all percentages and parts are by weight unless expressly stated otherwise.

DEFATTED EGG YOLK SOLIDS

The defatted egg yolk solids to be used in the present invention must have its protein present in non-denatured form, as indicated by a protein solubility index of 1.5 or greater as determined by the method basically described by Bishov and Mitchell, *Food Re-*

search, Vol. 19, pages 367—372 (1954) and discussed by Akerboom-Melnick in U.S. Patent 2,844,470. Preferably from 50% to 90% of the native egg yolk fat must also have been removed from the egg yolk solids.

A typical process for making satisfactory defatted egg yolk solids involves extracting dried egg yolk solids with a non-polar solvent, preferably an aliphatic hydrocarbon solvent such as n-hexane, to remove the coalesced fat and the readily extractable cholesterol. The preferred fat-extracted egg yolk solids are substantially free of cholesterol, i.e., they contain less than 20% and more desirably less than 10% of the original native cholesterol.

The treatment of egg yolk solids with a non-polar solvent appears to disrupt the low density lipo-protein complex, and consequently extracts the triglycerides, cholesterol and, to some extent, the other lipid materials. Because of the nature of this extraction, it has been found desirable to add an emulsifying agent when refatting the extracted, defatted egg yolk solids.

THE EMULSIFYING AGENT

It is important that the emulsion be of the oil-in-water, rather than the water-in-oil type. An emulsifier that is either water dispersible or water soluble, hereinafter called the "water soluble" type, will flavor such an emulsion. Obviously, of course, such an emulsifier must be edible. The emulsifier may be added to the vegetable oil if it is also oil dispersible; otherwise, it should be added to the water in which the defatted yolk solids are hydrated. It may be desirable to use more than one emulsifier. Surprisingly good emulsions of the oil-in-water type can still be made on adding a vegetable seed oil without benefit of added emulsifiers to the hydrated defatted yolk solids described above. The defatted yolk solids were obtained by a process which leaves behind with the egg yolk portion, a very large portion of the phospho-lipids while most of the fat is extracted.

Such resulting emulsions provide after spray drying acceptable refatted egg yolk solids for many applications, such as in cake and custard formulations. However, emulsifiers are preferably added in making the refatted egg yolk solids of the present invention if such are to be used in making mixes for producing scrambled eggs or omelets.

The following emulsifiers of the water soluble type have been found to be particularly suitable as a surface active agent which performs the primary function of providing sufficient dispersive forces to the fat globules to effect gravitational stability of the finished emulsion. It has also been observed that this kind of emulsifying agent works in conjunction with the small amount of the residual egg fat, still in lipo-protein combination, in the novel defatted yolk solids.

1. Water-soluble and water-dispersible emulsifiers containing polyoxyethylene chain(s) such as the partial fatty acid esters of polyhydric alcohols containing at least one polyoxyethylene chain, complete fatty acid esters of the condensation products of polyhydric alcohols and ethylene oxide in which all of the hydroxyl groups of the alcohols contain polyoxyethylene chains, partial fatty acid esters of polyoxyethylene glycol and complete fatty acid esters of polyoxyethylene glycol, the oxyethylene units per mol of each of said members being at least five and each fatty acid group in said members containing at least twelve carbon atoms. More specific examples of these emulsifiers are the partial fatty acid esters of polyoxyethylene sorbitan such as polyoxyethylene (20) sorbitan monostearate (also known as Polysorbate 60). These compounds are water-soluble, hydrophilic emulsifiers, and are readily available commercially.
2. Certain commercial grades of glyceryl esters, particularly commercially available glyceryl mono-oleate, which is essentially a blend of glyceryl mono-oleate, glyceryl dioleate and potassium oleate. Such a product is sold by Glyco Chemical Company as "S—1787". The emulsifier is oil-soluble and water-dispersible, the potassium oleate fraction being water-soluble.
3. Potassium oleate itself has been found to be effective as the emulsifying agent.
4. Diacetyl tartaric acid esters of mono- and di-glycerides of fat-forming fatty acids: A commercially available product of this type is sold by Hachmeister, Inc., under the tradename TEM 4T. It consists of diacetyl tartaric acid esters of mono- and diglycerides of stearic and palmitic acids, and contains about 51% by weight hydrophilic and 49% lipophilic groups. The emulsifier dissolves in oil and is readily dispersible in water.
5. Commercial soybean lecithin, which is a naturally occurring mixture of similar compounds identified as phosphatides or phospholipids, namely, lecithin (phosphatidyl choline) cephalin (phosphatidyl) ethanolamine), lipositol or inositol phosphatides (phosphoinositides) and related phosphorus-containing lipids. One such product manufactured by Yelkin Chemical Co. under the tradename "BTS", contains from 54% to 72% phosphatides dissolved in soybean oil. This product is soluble in oil and dispersible in water.
6. Split lecithins, which are soluble in oil and dispersible in water. These are commercial lecithin products which have had the ratio of phosphatides changed in order to accentuate their separate emulsifying

and surface active properties. These products are available commercially.

7. Several mixtures and combinations of emulsifiers may also be used. A commercially available product is a blend of three parts glyceryl monostearate and one part stearyl-2-lactylic acid.

8. A phosphated mono- and diglyceride, preferably as the sodium salt. An acceptable product is sold by the Witco Chemical Company, Inc., under the tradename Emcol-D—7031.

The above emulsifiers are preferably added to the oil phase with the exception of the potassium oleate and the sodium salts of the phosphated mono- and diglycerides. These latter emulsifiers are so preferentially water-soluble that they are added to the water in which the defatted egg yolk solids are dispersed.

The phosphated mono-diglyceride, which is hot water soluble, is the preferred emulsifier. Included in the removal of the easily extractable fat from conventional egg yolk solids, are portions of lecithin and lysolecithin which are the major components of egg phospholipids. A replacement of the extracted lecithins with a commercial soybean or split lecithin considerably improves the texture of the cooked egg products but can result in a less acceptable product due to the emergence of the characteristic lecithin flavor. It was found that, if a phosphated mono-diglyceride was substituted for the lecithin, the texture of the finished product was equivalent to the product which contained lecithin.

It is preferred to use a combination of three different kinds of emulsifiers. For example, a combination of phosphated mono-diglyceride, glyceryl mono-oleate and polyoxyethylene (20) sorbitan monostearate (Polysorbate 60) has been found to be an excellent blend of emulsifying agents.

The amount of emulsifying agent that is used depends upon many factors, such as, for example, the type of or mixture of individual emulsifiers used, the relative proportions of solids, oil and water used, the time lag between emulsification and drying, the desired "tightness" of the emulsion, the kind of drying to be employed, the amount of emulsifier already present in the added vegetable oil, if any, and so on. Generally, the greater the proportion of oil present in the mixture that is to be emulsified, the greater the amount of emulsifying agent that is required. About 0.25% by weight of the total emulsion or about 0.75% in terms of total solids, approaches the lower limit for a preferred emulsion of adequate stability to produce a preferred finished product. Such emulsion has the following general composition:

Ingredient	*Parts*
Dried defatted yolk solid	100
Vegetable oil	40—230
Water	100—800

The amount of emulsifying agent can be increased substantially without deleterious effect, but of course, at added expense and with the possibility of being detected by flavor. With the preferred mixture of emulsifiers, about 0.8% of the emulsifying mixture is excellent for emulsions with even a high vegetable oil content. With the less-preferred emulsifiers, amounts as high as 2.5% may be used.

THE VEGETABLE OIL

The edible vegetable oil used may be any edible digestible oil, free of cholesterol and one that is normally liquid or partially liquid at room temperature. Such oils are preferably the polyunsaturated vegetable seed oils such as corn oil, cottonseed oil, soybean oil, safflower oil, sunflower seed oil, rice bran oil, and sesame seed oil. Vegetable seed oils such as peanut oil likewise give excellent products as do the partially hydrogenated vegetable seed oils; they differ only in providing less polyunsaturates. Even the vegetable oils of the coconut oil type, which are also free of cholesterol, may be used to provide egg products substantially free of cholesterol and organoleptically highly acceptable.

The edible oil content of the refatted egg yolk product will depend upon the residual fat content of the defatted yolk solids, as well as upon the amount of oil that is used for refatting. Preferably, from 50% to 90% of the native egg yolk fat will have been removed from the egg yolk solids during the defatting process. The defatted yolk solids then contain from 50% to 10% of the original native fat.

Generally, for each 100 parts of defatted yolk solids, it is desirable to use 40—230 parts of vegetable oil and preferably 80—120 parts. This provides products varying in total fat content of from 35% to 80% on a total solids basis and preferably from 45% to 70% and most desirably from 55% to 65% to approximate the normal fat content of conventionally dried egg yolk solids.

The original fat in the egg yolk solids is replaced by a vegetable oil, preferably a vegetable seed oil in an amount between 10% and 70% by weight of the refatted egg yolk solids. The minimum amount of oil added is that required to impart good eating qualities to the egg product when used to prepare scrambled eggs. Whereas all of the products of the present invention are greatly reduced in cholesterol content, at least a 50% reduction, only those made with the vegetable seed oils will provide a product of increased poly-

unsaturated and reduced saturated fatty acid content. The preferred products of this invention will have a ratio of polyunsaturated to saturated fatty acid content in excess of 1.0 and desirably in excess of 2.0.

COLORING AGENT

Beta carotene is a preferred colorant; however, annatto coloring or any edible colorant which will impart an attractive yellow appearance to the refatted product can be used if desired.

FLAVORING AGENT

The preferred flavoring material is salt. It can be added either with the defatted egg yolk solids or to the water when preparing the emulsion or to the refatted egg yolk solids after spray drying.

Since the presence of salt improves the spray drying operation by increasing the percentage of the non-fat solids, the salt is preferably added to the emulsion in amounts to taste generally 0.25% to 2% by weight of the emulsion. This is equivalent to 0.75% to 6% in terms of the dehydrated refatted egg yolk solids. Other flavorant materials, such as cheese, pepper, ground dried vegetables and monosodium glutamate, may also be added at some appropriate stage. No salt is added in preparing products for those on a salt-free diet.

AQUEOUS COMPONENT

The aqueous component of the emulsion is essentially potable water. The amount used in preparing the emulsion can be adjusted to process needs and may vary from 40% to 85% of the emulsion, preferably 60% to 70%, i.e. 30% to 40% solids in the preferred emulsion. For spray drying, the amount of water to be used in the emulsion is a function of the type of spray dryer utilized. Water contents in the emulsion as high as the 85% indicated above had been used with good results. The reasons for avoiding high water contents are economic rather than technical.

It is preferred to incorporate into the aqueous phase a small amount, up to 1% by weight of the emulsion, of material such as a phosphated mono-diglyceride or lecithin. This material is a desirable additive, since it imparts proper texture characteristics to cooked egg foods made with the end products of this invention.

pH ADJUSTMENT

Before drying, the pH of the aqueous suspension in the mixture is preferably adjusted to a range of 7 to 8, most desirably to 7.5. This can be accomplished by the addition of alkalizing materials such as alkaline sodium phosphate or sodium hydroxide. Alternatively, these alkalizing materials and others, such as baking soda, potassium bicarbonate and sodium bicarbonate, may be added to the dried refatted yolk solids, so that upon rehydration, the resulting emulsion will have a pH in the range of 7 to 8, most desirably at about 7.5.

If the prepared emulsion is to be held for any length of time, either before or after pasteurizing, it should be chilled to a temperature below 45°F. because of the danger of microbial growth.

After the refatted, low cholesterol yolk emulsion is pasteurized (when such is called for), it is preferably spray dried, to reduce the moisture content to 5% or less. The inlet temperature of the dry air may range from 275°F. to 400°F. and the outlet air temperature may range from 150°F. to 175°F. Under these specified conditions, the temperature of the solids should not be greater than 150°F. Alternatively, any other suitable method of drying may be used, with or without prefreezing before drying.

The defatted egg yolk material used in the present invention may have residual solvent up to an amount of about 150 parts per million, or even higher. It has been noted that during the refatting and spray drying operation in accordance with the present invention, the solvent is removed so that the final refatted material contains less than 10 ppm. In fact, it has not been possible organoleptically to find even trace amounts of solvent in the material. However, analytical procedures permit a detection of only about 10 parts per million. Since none was detected it may be accurately stated that the material contains less than 10 parts per million, which is less than an insignificant trace quantity.

The dry, refatted yolk solids are in the form of discrete particles. This product, when mixed with dried agg whites and/or other materials, as described in Example 5, reconstitutes readily with water and upon cooking provides an excellent scrambled egg or omelet but now one that can be included in diets designed to control the serum cholesterol level.

To obtain a more free-flowing product up to 2%, by weight, of an anticaking agent may be added to the dry refatted, low-cholesterol yolk solids. Typical examples of anticaking agents include sodium aluminum silicate, sodium silicate, tricalcium phosphate and granular silica gel.

THE CONVENIENCE PACKAGE

In the drawings:

Figure 1 is a side elevation of a cardboard carton for holding pouch containers of food components packaged in accordance with one preferred embodiment of this invention;

Figure 2 is a section taken on the line 2—2 of Figure 1, looking in the direction of the arrows, and showing two pouches of food products within the carton;

Figure 3 is a side elevation of a package prepared in accordance with another embodiment of the invention, showing an exterior pouch within which both the food product

and a smaller pouch are included, the view being partly broken away to show the smaller pouch and its contents;

Figure 4 is a section taken on the line 4—4 of Figure 3, looking in the direction of the arrows;

Figure 5 is a side elevation of a package in accordance with another embodiment of the invention, in which two separate pouches are united so as to provide a unitary package, and

Figure 6 is a section taken on the line 6—6 of Figure 5, looking in the direction of the arrows.

This embodiment of the present invention provides in a convenience package, components of the instant type that can easily be made up, by mixture and rehydration, to form a composition that can be cooked to provide a delicious egg dish. According to one preferred embodiment of this invention, the package comprises two separate pouches. These contain, respectively:

(a) an easily rehydratable, dry egg material of small particulate size, and

(b) a food of gross particulate size in ready-to-eat form without further hydration, and that is also microbiologically and organoleptically stable.

Both pouches are made of tough, flexible, waterproof, preferably transparent plastic film, and are sealed. The amounts of their respective contents are proportioned to form a composition that, after rehydration of the egg component, mixture, and cooking, provides an attractive egg-based dish.

The easily rehydratable dry egg material consists of particles each less than 2 millimeters and preferably less than 1 millimeter in maximum dimension.

The food of gross particulate size, which has been processed to be microbiologically and organoleptically stable, is a material such as, for example, simulated bacon crisps, vegetable salad, ham salad or sausage salad. The vegetable, ham, or sausage in their respective salads are in stabilized, hydrated, ready-to-eat form. The ham and sausage components may be meat products but preferably are meat analogs, based upon vegetable protein. In each case, the material of gross particulate size is in its maximum dimension greater than 3 millimeters, and generally greater than 5 millimeters.

The present invention may be more easily understood if these two components are discussed individually as follows.

REHYDRATABLE DRY EGG MATERIAL

The first sealed, substantially moisture-proof pouch contains dry refatted egg yolk solids prepared in accordance with this invention.

The dried refatted yolk solids are intimately admixed with dried egg white solids in amounts approximating the natural proportions, that is, approximately 28.5 parts of dried egg white powder to 71.5 parts of dried refatted yolk solids.

In preparing the rehydratable material, other edible constituents, such as skim milk powder, a carbonation system and flavoring compounds, may be blended with the dry egg solids. The pH of the egg material (tested after rehydration in 10% aqueous suspension) usually falls in the range between 6 and 8. The product is stable in its dehydrated form.

The dried egg product is packaged in a substantially moisture-proof pouch. The pouch is preferably made from a heat soluble film such as a polyethylene film or a polyvinylidene chloride film ("Saran", Registered Trade Mark), preferably laminated to aluminum foil. The solid egg product is in powdered form and therefore is easily divided into portions suitable for unit or multi-unit consumption form.

This dried egg product constitutes the food materials which are easily rehydratable and of small particulate size having a maximum particle size of less than 2 millimeters.

Upon mixing with water, in an amount of about 3 to 4 times as much water as egg solids on a weight basis, the egg solids rehydrate instantly, that is, within one minute. The rehydrated mixture may then be pan fried, baked or cooked in any other desired manner, to provide an omelet, scrambled eggs, or other egg-based dish.

FOOD OF GROSS PARTICULATE SIZE

The gross particulate food is the adjunct to the egg and is usually the component of conventional egg combination dishes which is most difficult to prepare. If packaged in dehydrated form, for example, requiring hydration for organoleptic acceptability, it is the product which requires an excessive amount of time to hydrate.

The gross particulate food in the products of the present invention is a stabilized, ready-to-eat adjunct. The food, if moist, is microbiologically and organoleptically stabilized. Whether moist or dry, no further hydration is required prior to consumption.

An example of the gross particulate food in dry ready-to-eat form includes simulated fried bacon strips, manufactured from vegetable materials, as described more fully hereafter. Preferred examples of the gross particulate food in moist ready-to-eat form are vegetables in moist form or in a salad dressing base; a ham analog, made predominantly from a vegetable-protein, in a moist form or in a salad dressing base; and a sausage-like product in subdivided form, made from a vegetable protein, and in an aqueous or salad dressing base. The foods of gross particulate size are preferably substantially free of cholesterol.

The food material in gross particulate form

has a particle size in excess of 3 millimeters in its maximum dimension and preferably in excess of 5 millimeters in its maximum dimension.

If the gross particulate food material is in a moist form, it is stabilized against microbiological and organoleptical deterioration. Such stabilization is effected by the addition of an edible fungistat and a water-soluble metal chelating agent in an acetic acid environment. Suitable fungistats include organic free carboxylic acids and their edible alkaline metal salts. Examples of such acids are propionic, crotonic, sorbic, benzoic, and para-hydroxy benzoic acid and the sodium potassium and calcium salts thereof. Suitable water-soluble metal chelating agents include amino polycarboxylic acids such as ethylenediaminetetraacetic acid, polycarboxylic acids such as succinic acid, hydroxy polycarboxylic acids such as citric acid, polyhydroxy compounds such as inositol, and amino acids such as glutamic and aspartic acid.

It has been found that the combination of the fungistat and water-soluble metal chelating agent is exceptionally useful in preventing deterioration of a food salad product. Neither the fungistat nor the metal chelating agent alone produces as satisfactory a result. The water-soluble metal chelating agent is generally used in the food in the amount of 0.0004% to 2% by weight. The quantity of the fungistat present in the food varies depending upon the fungistat used, and will usually fall in the range from 0.015% to 0.30%. For example, fungistats of the sorbic acid and benzoic acid type are present in the food in amounts from 0.015% to 0.2% by weight, preferably 0.05% to 0.15%, whereas fungistats of the propionic acid type require somewhat higher concentrations in the foods, usually in amounts of from 0.15% to 0.3%.

The outstanding use of the fungistat and chelating agent in synergistic combination is in regard to food salads wherein the solid food component is for example, vegetable or meat, and the dressing is, for example, vinegar alone, mayonnaise salad dressing, French dressing; the latter dressing are classified generically as salad dressing. It is necessary, in order for the fungistat and chelating agent to function synergistically, that the pH be below 5 and preferably below 4.5. The primary acid that is used in attaining these pH values is acetic acid. The pH values are preferably between 3.5 and 4.5. For effective synergistic combination of the fungistat, chelating agent, and acetic acid, each of these protective agents must be distributed evenly through both the solids in the solid food of gross particulate size and through the surrounding aqueous or salad dressing medium. Most desirably, the solid food component, i.e. vegetable or meat, which is combined with the dressing component, is heat processed at some stage so that it does not constitute a source of undesirable enzymic reactions or contribute undesirable microorganisms.

The presence of the fungistat, chelating agent and acetic acid permit long term storage of the packaged foodstuff, in ready-to-eat form, without need of refrigeration, although in some cases the latter is desirable.

The final, reconstituted, mixed, and cooked egg-combination food product ordinarily has a pH above 6, usually, between 6.5 and 8.5, tested as a 40% aqueous suspension. The low pH of the food of gross particulate size does not adversly affect the flavour or pH of this final product.

The ready-to-eat food of gross particulate size is packed in its pouch in an amount in the range from 0.25 to 2.0 parts by weight for each part by weight of the easily rehydratable dry egg material. Generally, the gross particulate food supplement is packed in an amount in the range from 0.4 to 1.2 parts by weight for each part by weight of the dry egg material.

The preferred reconstituted, mixed, and cooked egg-combination food products are substantially free of cholesterol. That is, they contain less than 20%, and more usually less than 10%, of the cholesterol quantity found in the usual serving of the egg product combination made with conventional components. Moreover, the fat component has a ratio of polyunsaturated to saturated fatty acids of at least 1.0.

The invention will be further illustrated by a number of detailed examples. Examples 1 to 7 relate to the refatted egg yolk products of the present invention, the preparation thereof, and the uses thereof. Examples 8 to 11 illustrate the convenience package. All parts and percentages are by weight unless expressly stated to be otherwise.

Example 1.

It is preferable to premix the constituents in groups and then form the desired emulsion which is subsequently spray dried. The ingredients used in this example are set forth below in these premixed groups. The first group is the oil constituent, the colorant, and the oil emulsifiers. Group 2 constitues the dry ingredients and Group 3 the aqueous component including its emulsifier. The quantities of the ingredients appear below.

	Ingredient	Parts
Group 1	Corn oil	16.4
	Polyoxyethylene (20) sorbitan mono-stearate	0.2
	Glyceryl mono-oleate	0.3
	B-carotene concentrate (equivalent to 500,000 USP units of vitamin A per gm.)	0.005
Group 2	Defatted yolk solids (11.1% residual native fat and 0.53% cholesterol; protein solubility index of 1.8)*	14.7
	Salt	1.1
Group 3	Water	67.0
	Phosphated mono-diglyceride	0.3

*Percentages are based on original product before defatting.

The mixture of all three groups was placed in a single mixing tank, aqueous component first (Group 3), then the solids (Group 2). This solution was mixed thoroughly until all of the dry material was dispersed, then the oil phase (Group 1) was added gradually with vigorous mixing. The premix was fed through a colloid mill, with the gap setting between rotor and stator at 6 mils. The resulting emulsion was pasteurized at 143°F. for 3½ minutes, then chilled to 45°F. until it was spray dried. The emulsion was spray dried in a spray drier with an inlet dry air temperature of 350°F. and an outlet air temperature of 160°F.

The resulting dry, refatted, low-cholesterol yolk solids were in the form of discrete particles. Silica gel, 0.5% by weight, was added to improve the flow characteristics, and 2.0% sodium bicarbonate was added to adjust the pH upon rehydration to between 7.0 and 8.0. The pH adjustment may be made earlier in the process as shown in the drawing using a dilute sodium hydroxide solution. The moisture content of the product was 2.6%.

The defatted egg yolk material used in this example exhibited a solvent content of approximately 150 parts per million. After refatting the final product was analyzed for solvent content. The results were less than 10 parts per million, i.e. no trace.

In Table II, the chemical composition of the refatted egg yolk solids of Example 1 is compared with that of a typical sample of conventional stabilized egg yolk solids. The cholesterol content of the refatted egg yolk solids of this example was 410 milligrams per 100 grams of product, as compared to a cholesterol content of 2980 milligrams per 100 grams in conventional dry egg yolk solids.

The total fat content of these dry egg yolk solids was 59.5%, as compared to 57.6% typically found in conventional dried egg yolk solids.

The ratio of polyunsaturated to saturated fat in the product of this example was 3.0. The ratio of polyunsaturated to saturated fat found in a typical sample of conventional dry egg yolk solids was 0.4. Table II illustrates the composition of the refatted, low-cholesterol yolk solids in comparison to conventional egg yolk solids.

TABLE II

Composition of Conventional Stabilized Egg Yolk Solids and Refatted Egg Yolk Solids

	Conventional, stabilized Egg Yolk Solids	Refatted Egg Yolk Solids
Total Fat, %	57.6	59.5
Fatty Acid Composition Saturated Fatty Acids, % Total Fat	34	17.6
Monosaturated Fatty Acids % Total Fat	52	29.2
Polyunsaturated Fatty Acids, % Total Fat	14	53.2
Polyunsaturated/saturated ratio (P/S ratio)	0.4	3.0
Protein, %	33.4	27.7
Cholesterol, %	2.98	0.41
Moisture, %	4.8	2.6

The refatted, low-cholesterol yolk solids from Example 1 may be used as a replacement for conventional egg yolk solids, or when rehydrated in a 1:1 ratio with water, as a replacement for fresh liquid egg yolk.

After storage for one year at room temperature in a closed container with air in the headspace, the products of this example exhibited no deterioration. In fact, no detectable differences from freshly prepared products were observed.

The following table illustrates additional examples embodied in this invention. Following this table are further details concerned with the preparation of Examples 2—4.

TABLE III

Additional Examples of Components of Refatted, Low Cholesterol Egg Emulsions

Ingredient	Example 2	Example 3	Example 4
	Parts	Parts	Parts
Water	70.0	65.0	80.0
Defatted, low-cholesterol egg yolk solids (10% residual native fat and 0.41% cholesterol; protein solubility index of 1.8)*	12.0	14.7	7.5
Salt	1.0	1.1	0.7
Corn oil	17.1	17.2	10.8
Phosphated mono-diglyceride	—	—	0.3
Lecithin	0.5	—	—
Sodium hydroxide	1.6	—	1.0
Glyceryl mono-oleate	0.3	—	0.2
Polyoxyethylene (20) sorbitan monostearate	0.5	—	0.3
B-Carotene concentrate (equivalent to 500,000 USP units of vitamin A per gm).	0.005	0.005	0.005
Egg white solids	—	—	8.5
Non-fat milk solids	—	—	3.3
Guar gum	—	—	0.5

*Percentage is based on original product before defatting.

EXAMPLE 2.

Water, defatted, low cholesterol egg yolk solids, corn oil, emulsifying agents, lecithin, sodium hydroxide, salt, and B-carotene were combined in the proportions set forth in Table III and treated as in Example 1, with the lecithin and sodium hydroxide being incorporated in Group 3. The resulting product was dispersible in water, and as in Example 1, exhibited the characteristics of natural dried egg yolk solids. When combined with the proper proportion of egg white solids, the resulting product was a satisfactory replacement for whole egg solids.

When mixed in proper proportions with the omelet mix ingredients in Example 5, then reconstituted and cooked as either an omelet or scrambled eggs, the resulting product was very satisfactory with acceptable flavor and excellent texture.

EXAMPLE 3.

Water, defatted, low-cholesterol egg yolk solids, corn oil, salt and B-carotene, were combined in the proportions set forth in Table III and treated as in Example 1. The resulting product was completely dispersible in water and exhibited the characteristics of natural spray dried egg yolk solids. When combined with the proper proportions of egg white solids, the product was a satisfactory replacement for whole egg solids. When mixed in proper proportions with the omelet mix ingredients in Example 5, then reconstituted and cooked as either an omelet or scrambled eggs, the resulting product was very satisfactory, with excellent flavor and acceptable texture.

EXAMPLE 4.

In this example, water, defatted, low-cholesterol egg yolk solids, corn oil, egg white solids, non-fat milk solids, salt, emulsifiers, sodium hydroxide, guar gum, and B-carotene were combined in the proportions shown in Table III, and processed to a dry mix as described in Example 1. The sodium hydroxide was incorporated in the aqueous component (Group 3), while the egg white solids, guar gum, and non-fat milk solids were incorporated in Group 2. When the resulting product was blended with the other dry ingredients shown in Example 5, rehydrated and cooked, the result was scrambled eggs or omelets of exceptional flavor and quality.

Dry refatted whole egg solids, prepared by mixing the refatted egg yolk solids from any of the previous examples, with dry egg white solids in the natural proportion of 71.5% yolk solids to 28.5% white solids duplicates, upon rehydration, the functional properties of conventional dried and rehydrated whole egg solids. The refatted, dry whole egg solids can be rapidly and efficiently dispersed in liquid media, e.g. water, milk, or other edible liquids commonly used to rehydrate dried eggs.

When the refatted egg yolk solids, from any of the previous examples, were mixed with dry egg white solids in certain proportions and substituted for whole eggs in preparing many food items, i.e. waffles, biscuits, French toast, pound cake, and pancakes, products were obtained which were superior in taste and texture to similar products made with conventional whole egg solids. From the nutritional standpoint, all of these food products had the advantage of a much lower cholesterol content and a much higher ratio of polyunsaturates to saturates, as compared with the same products made with whole eggs or conventional whole egg solids. (See Table II).

For direct consumption, the refatted yolk solids of this invention, with pH values of 7.0—8.0, are combined with dried egg whites, admixed with the proper proportions of non-fat milk solids, vegetable gum, a leavening agent, sugar and spices, and mixed with water (1 part egg product plus 3—4 parts water) to form an emulsion with a consistency like liquid whole eggs. The emulsion is then cooked in the same manner as scrambled eggs. After cooking, the product resembles conventional scrambled eggs, but has a flavor superior to scrambled eggs prepared from conventional whole egg solids.

Thus, another aspect of this invention is the embodiment of the refatted, low-cholesterol yolk solids with other ingredients which will, upon rehydration and cooking, result in a product which resembles scrambled eggs or omelets, depending on the method of cooking, but has a flavor superior to similar products prepared from conventional dry whole eggs and equal to that of fresh eggs.

The refatted, low-cholesterol egg yolk solids may be present in the scrambled egg-omelet mix in the range of 50% to 68%. Amounts above and below this range may result in a product inferior in flavor and texture characteristics, although they may still be acceptable.

The dry egg white is preferably spray dried. The amount of added egg white powder will correspond generally to the proportion of 30—80 parts of egg white solids to 100 parts of refatted, low-cholesterol egg yolk solids. The normal proportion is about 40 parts of egg white solids to 100 parts of the refatted, low-cholesterol egg yolk solids. The higher levels of egg white solids contribute to a more cohesive coagulum on frying a rehydrated omelet mix.

The addition of non-fat milk solids enhances the color and improves the texture of the reconstituted whole egg product upon cooking as either an omelet or scrambled eggs. The amount of non-fat milk solids in the product may range from 5 to 15 percent.

The incorporation of a leavening agent improves the lightness of texture of the reconstituted cooked product. The omelet can contain as much as 1.5% of leavening material, depending upon the agent used or it may be omitted entirely.

Minor amounts of vegetable gum may be incorporated in the mix. Suitable gums include guar gum, cellulose gum, gum tragacanth, and gum arabic. These materials aid in water absorption upon reconstitution and also add desired body to the product. They are preferably present in amounts from 0.5 to 2.5%, depending upon the type of vegetable gum.

The reconstituted omelet mix should have a pH in the range of 7—8, preferably 7.5. To attain a pH in this range, a suitable alkalizing agent, such as sodium bicarbonate, potassium bicarbonate, sodium carbonate, or the like is added with the other dry ingredients of the omelet mix, if an alkalizing agent has not previously been added during the preparation of the refatted, low-cholesterol egg yolk solids. The proper pH will improve the texture of the reconstituted cooked product. The omelet mix will generally require from 1 to 4% alkalizing agent, depending upon the initial pH and the material used.

From 1.0 to 2.0% sugar and/or spices may be added to enhance the egg flavor.

EXAMPLE 5.

This example is one formulation which may be used in preparing a scrambled egg or omelet mix using the refatted low-cholesterol egg yolk solids of this invention. A quantity of spray dried, refatted, low-cholesterol egg yolk solids, as prepared in Example 1, was blended with other dry constituents in the amounts set forth in the following Table.

TABLE IV

Constituents	Percent by Weight
Refatted, low-cholesterol yolk solids (Example 1)	65.0
Powdered egg white	24.2
Non-fat milk solids	7.2
Baking powder	0.8
Guar gum	1.6
Sugar, spices	1.2
	100.0

The product was readily reconstituted with suitable quantities of water, milk, skimmed milk, or mixtures thereof. After reconstitution with water, the egg product was poured into a pan having a small amount of melted fat and was cooked in the conventional manner for a minute or so. This time compared favorably with that required for the scrambling of fresh eggs.

To obtain the equivalent of one liquid egg, about 16 grams of the dry egg product were added to about 60 grams of water ($\frac{1}{4}$ cup). The finished omelet or scrambled egg duplicated the texture and color of similar products made with conventional dry whole egg solids, but possessed a superior flavor like that of fresh eggs.

The cholesterol content of the rehydrated whole egg product was about 57 milligrams per 100 grams of total product, including the reconstituting liquid, as compared to about 540 milligrams per 100 grams of liquid whole egg.

The fat content of the rehydrated whole egg product was similar to that of whole eggs; however, the P/S ratio of the fat was in excess of 2.

It has been shown through this invention how a refatted, low-cholesterol egg yolk material which is high in polyunsaturates, low in saturates, and possesses outstanding storage stability, can be produced. This material can be used, without the addition of other ingredients, as a replacement for either liquid egg yolks or conventionally dried egg yolk solids in recipes and in other food formulations. With the addition of the proper amount of egg white solids, this material may be used as a replacement for either whole eggs or conventionally dried whole egg solids.

It has been pointed out throughout this application that the refatted, low-cholesterol egg yolk solids can be used in making formulated food products with high convenience.

In one embodiment of the contemplated food products, modified yolk solids are formulated with other ingredients to produce a convenient, dry omelet mix which, when reconstituted and cooked, results in a superior scrambled egg or omelet product.

Yet another use for the refatted, low-cholesterol egg yolk solids of this invention is in the preparation of commercially formulated convenience foods which would provide all the functional and nutritional benefits associated with the presence of egg yolk solids, in addition to providing a superior egg flavor and outstanding storage stability.

Following are examples of some formulated food products for consumer use, made with the refatted, low-cholesterol egg yolk solids of this invention.

EXAMPLE 6.

INSTANT CUSTARD MIX

Refatted, low-cholesterol egg yolk solids, as prepared in Example 1, sugar, calcium carageenan, tetrasodium phosphate, salt and flavoring and coloring agents, were mixed together in the proportions shown below. When packaged, the product was readily dispersible and had excellent storage stability without degradation of quality.

To prepare the instant custard, 2 ounces of this mix was added to 1 cup of milk and heated to boiling, with stirring. The mixture was then removed from the heat, poured into custard dishes and allowed to cool. Upon cooling, the product set up to a custard-like consistency and possessed good flavor.

TABLE V

Ingredient	Parts
Sugar	55.0
Refatted, low-cholesterol egg yolk solids (Example 1)	10.0
Calcium carageenan	1.5
Tetrasodium phosphate	0.6
Salt	0.3
Flavoring and coloring agents	as required

EXAMPLE 7.

INSTANT BREAKFAST DRINK

The refatted, low-cholesterol yolk solids, as prepared in Example 1, were mixed with sugar, non-fat milk solids, egg whites, calcium carageenan, vitamins, mineral supplements, flavoring and coloring agents in the proportions shown below. The resulting mix was readily dispersible and had excellent storage stability with no degradation in quality.

This product was made into a nutritious, satisfying drink almost immediately by adding 1½ ounces of the dry mix to 1 cup (8 ounces) milk and stirring until dissolved, about 30 seconds.

TABLE VI

Ingredients	Parts
Refatted low cholesterol yolk solids (Example 1)	10.0
Sugar	10.0
Non-fat milk solids	10.0
Egg white solids	4.0
Calcium carageenan	0.25

The flavoring agents, coloring agents, vitamins and minerals are added in standard proportions such that the desired flavor and color and nutritional value are attained. Such flavoring agents as strawberry, chocolate, and coloring agents such as red, brown, yellow, etc. are incorporated as desired for the specific formulation.

Other uses for the refatted egg yolk products of the present invention include food products such as mayonnaise, sponge cake and salad dressings. Whether or not the refatted egg yolk solids are combined with dry egg white is dependent upon the desired final product. The egg yolk solids of the present invention may be combined with egg white in dry form in any proportion desired. The egg products of this invention are also of value in the form of aqueous slurries, distributed in a refrigerated state every few days to the institutional trade.

EXAMPLE 8.

SPANISH STYLE OMELET

The rehydratable dry egg material:

Water, defatted egg yolk solids, corn oil, emulsifying agents and salt were combined in the proportions set forth below. The mixture was emulsified and then flash pasteurized and spray dried. The resulting product was dispersible in water and exhibited characteristics of natural dried egg yolk solids but was exceptionally and desirably bland in flavor.

Ingredients	Percent by Weight
Water	67.0
Defatted low cholesterol yolk solids	14.7
Phosphated monoglyceride	0.3
Salt	1.1
Corn oil containing added carotene	16.4
Glyceryl mono-oleate	0.3
Polyoxyethylene (20) sorbitan mono-stearate	0.2

The dried, refatted egg yolk solids were blended with dried egg white and non-fat milk solids in the ratio of 24.2 parts of the egg white solids to 65.0 parts of the egg yolk solids to 7.2 parts of the non-fat milk solids. Supplementary materials including a carbonation (baking powder) system, gum, and flavorings were added in small amounts totalling 3.6 parts. The pH of the dry egg material (tested after rehydration) was 7.3. This rehydratable dry egg material, of particulate size of less than 2 millimeters, was packaged in unit consumption form, in heat sealable pouches made from a laminated material of "Saran" film, aluminum foil, and kraft paper. The polyvinylidene chloride ("Saran") film was on the interior of the pouches, in contact with the dry egg solids product. The foil is an insulator and shields against moisture and air permeation, and the kraft paper permits printing on the exterior.

Each pouch was sealed and these components of the food convenience package were then ready to be packed in cartons, each one with one of the other sealed pouches containing the gross particulate food material.

The food of gross particulate size:

This was a vegetable salad prepared as follows:

Dressing Component	Parts by Weight
Mayonnaise	43.81
Sugar	3.55
Vinegar (100 gr. Spirit)	1.89
Salt	1.20
Gum Tragacanth	0.21
Salad Oil	0.25
Sorbic Acid	0.025
Ethylenediaminetetraacetic acid as its calcium disodium salt	0.003
Total	50.928

Dehydrated Vegetable Component (rehydrated basis) -	Parts by Weight
White and French chopped onion	16.47
Green sweet pepper	8.19
Carrot	8.15
Pimiento	8.15
Sweet relish	8.112
Total	49.072
GRAND TOTAL	100.00

Reconstitution Liquor for the Chopped, Dehydrated Vegetables	Parts by Weight
Water	93.77
Vinegar (100 gr. Spirit)	4.02
Salt	2.00
Sorbic acid	0.20
Ethylenediaminetetraacetic acid as its calcium disodium salt	0.01
Total	100.00

The dehydrated chopped vegetables were reconstituted in 6.5 parts of the above described reconstitution liquor per 1 part of vegetables at 45°F. for 20 hours. The vegetables were drained of excess liquor after the reconstitution period. These hydrated vegetable pieces were all in excess of 3 millimeters and most of them were well in excess of 5 millimeters in maximum dimension.

The drained vegetables and the dressing component were blended and filled into heat sealable pouches of the same construction as those in which the dry egg product was packaged. Two pouches of each kind were then placed in a carton, for sale as a food convenience package as in Figures 1 and 2. The net weights of the two pouches were the same.

For use, the egg product is removed from its pouch and is combined with 3 to 4 parts by weight of water by blending with a fork or with an electrical blending device, or the like. The contents of the second envelope are added to the mixture, just before or during the blending operation. The combined vegetable-egg batter is poured on a greased frying pan and the product is then cooked in omelet or scrambled egg style. The pH of the cooked product is about 6.8. From the time of opening the pouches to the serving of the Spanish style omelet, a period of only a few minutes is required.

Both the dry egg component and the moist salad component in their respective pouches are stable against microbiological and flavor deterioration, at ambient temperatures, for periods in excess of 12 weeks.

EXAMPLE 9.

EGG AND BACON-LIKE PRODUCT

Portions of the dry egg product of Example 8, of unit consumption size, were packaged in a substantially moisture-proof pouch of small size. Simulated bacon strips, to be described presently, were packed in a second, larger, moisture-proof pouch. The first pouch was sealed and placed in the second pouch and the latter was then sealed (see Figures 3 and 4). The simulated bacon strips were packed in the amount of 0.4 parts by weight for each part by weight of egg material in the first pouch.

The bacon strips were prepared from a dough that was made from the following ingredients:

Ingredient	% by Weight
All purpose cake flour	34.85
Vital Wheat Gluten	8.59
Pulverized H—O Quick Oats (Best Foods Div., Corn Products Co.)	12.18
Salt	8.02
Hydrolyzed Plant Protein	4.24
Hydrogenated Cottonseed Oil (102°F., mp; 63 I.V.)	14.90
Flavor	3.44
Water	13.75
Coloring	0.03

The flavor material was an imitation bacon flavor that was purchased from a commercial producer.

The dough was prepared from these ingredients in the following manner. All of the dry ingredients, except the food coloring, were mixed together in a planetary mixer. The shortening was then melted and added to the other ingredients. Blending was continued for a few minutes to obtain a crumbly mass with fairly uniform distribution of the shortening.

The coloring and water were then added to the mxer, and blended with the other ingredients, to produce a dough sufficiently moist to form a dough ball. A second batch of dough was then prepared in the same manner, but the coloring was omitted. These two dough formulations, identical to each other in physical characteristics, differing only in color, were fed in alternating fashion into a food press equipped with a die plate (Mafalde type) designed to produce ribbons of dough about 1.6 cm. wide and 1 mm. thick with rippled edges on both sides. The ribbons of raw dough were cut into strips at lengths of about 1—3 cm.

These strips were baked for about 10 minutes at about 325°F. and then were impregnated with a vegetable oil blend (mp of 110°F.) of hydrogenated coconut oil and hydrogenated soybean oil to which an oil-soluble smoke flavor was added. The analysis of the strips was found to be approximately 28% fat, 12% salt, and less than 1% water; by weight.

These strips had the appearance of strips of fried bacon. They were crisp; had curls and ripples, and showed distinct reddish-brown and light tan bands running parallel to the length of the strip. The physical appearance of these duo-colored chips strongs resembled fried bacon containing both lean and fatty portions. Their taste and texture were also excellent.

The pH of the product (tested in 10% aqueous suspension) was 5.8.

The simulated bacon strips were added to the omelet after cooking but they may be added at any time during frying of the egg material. It is preferable to add them during the latter stages of cooking or after cooking is completed. The pH of the end product combination was 7.8.

The final product was superior in many ways to what is possible with conventional products. In the first place, both egg and bacon analog were substantially free of cholesterol and the fat content possessed a ratio of polyunsaturated to saturated fatty acids in excess of 1.0. Secondly, the egg and bacon-analog product are stable against microbiological and flavor deterioration at room temperature for periods in excess of 20 weeks. Thirdly, from the time of opening the pouches to the serving of the egg and bacon-like product, a period of only a few minutes was required. These three aspects of unusual nutritional values, excellent stability and great convenience cannot be matched by present day eggs and bacon in any of its forms and combinations.

EXAMPLE 10.

EGG AND HAM-LIKE PRODUCT

The dry egg material was packaged in a first pouch of a substantially moisture-proof dual pouch package having a sealed strip uniting two separate pouches, as shown in Figures 5 and 6. A measured amount of a

simulated ham component, to be described presently, was packed in the second pouch.

The ham analog used in this example was made from soy protein fibers, cross-linked with egg albumen, the latter containing coloring and flavoring to simulate ham. It was in the form of small diced pieces of about ½ centimeter diameter, freeze-dried. However, it could be used in either moist or freeze-dried form.

When the ham analog is not dehydrated, it is made with the protective solution previously described, so that the protective agents are uniformly distributed thoughout this product.

To make the ham analog component, 17.2 parts by weight of the freeze-dried pieces were combined with 13 parts by weight of chopped pickle relish. The pickle relish provided the acetic acid. This combination was placed in 51.6 parts of a reconstitution liquor containing water, 99.766%; sorbic acid, 0.200%; and ethylenediaminetetraacetic acid, 0.034%. The ham analog and pickle relish remained in the reconstitution liquor at a temperature of 70°F. for two hours, after which the excess liquor was drained off and discarded. The blend after reconstitution was as follows:

Component	*Parts by weight*
Ham analog	43.0
Relish	13.0

The pH of the above components (tested as a 40% aqueous suspension) was 4.4. The gross particulate material of ham-like chunks in hydrated ready-to-eat form and the pickle relish were packaged in the second moisture-proof sealed pouch or envelope in the amount of 0.5 parts by weight for each part of egg material in the adjoining pouch. The two pouches, one attached to the other, were then placed in an exterior carton package for sale as a single convenience food package, in unit consumption size portions.

To use, the consumer removes the egg material from its pouch and adds it to 3 to 4 parts by weight of water. The contents of the second pouch are then added and the total mixture is well stirred and blended for about one minute. The material is then pan-fried with or without scrambling. The pH of the end product was 7.3. It had exceptionally good flavor and texture qualities. From the time of opening the pouches to the serving of the egg and ham-like product, a period of only a few minutes was required.

The packaged products were stable against microbiological and flavor deterioration for many weeks at room temperature, and for more than 16 weeks under usual temperatures of refrigeration (about 40° to 45°F.). Here also the combination of unusual nutritional value, good organoleptic qualities, stability, and high convenience cannot be matched by present day ham and eggs in any of its forms and combinations.

Example 11.
HAM-FLAVORED SALAD OMELET

The mixture of the reconstituted ham analog and pickle relish of Example 10 was combined with a modified mayonnaise dressing, as described below. This combination was packed in a moisture-proof sealed envelope, which was then placed in a cardbooard carton with a second envelope containing the same dry egg product that was used in Example 8.

The modified mayonnaise dressing, to which the ham analog and pickle relish mixture was added, was made up as follows:

Component	Parts by Weight
Mayonnaise	41.509
Artificial flavoring	2.010
Carboxymethyl cellulose	0.070
Salad oil	0.140
Sorbic acid	0.098
Ethylenediaminetetraacetic acid as its calcium disodium salt	0.089
Artificial color	0.084
Total	44.000

The 44 parts of mayonnaise dressing were blended with 56 parts of the mixture of rehydrated ham analog and pickle relish of Example 10. The pH of the resulting salad, tested as a 40% aqueous suspension, was 4.4.

The two envelopes provided the same net weights of packaged food materials. The two packages were then placed in cardboard carton for sale as a convenience food package.

A pan-fried egg combination food was prepared according to the method described for Example 10. The pH of the end product was 7.1. It had excellent organoleptic qualities. This product was also prepared in a matter of a few minutes.

GENERAL

The packaged food products of the present invention may be packed in a family size package containing enough of both components for the preparation of three to four individual servings. This size package would require a pouch of the egg material containing about 57 grams and a second pouch of the adjunct component in an appropriate amount. Alternatively, the convenience package may comprise a carton containing a multiplicity of individual small sealed pouches, each containing enough of one material for a single serving. The dry egg material in each such pouch would usually be about 19 grams, with the accompanying ready-to-eat adjunct material being packed in separate pouches in appropriate amounts, as specified earlier. The individual servings in the one carton may all be of the same egg-combination product or they may differ within a given carton.

We are aware of Colouring Matter in Food Regulations 1966, the Emulsifiers and Stabilizers in Food Regulations 1962 and the Preservatives in Food Regulations 1962 and we make no claim to the use of the invention in contravention of the law.

WHAT WE CLAIM IS:—

1. A particulate, substantially dry refatted egg yolk solids product comprising an intimate admixture: undenatured egg yolk solids from which at least 50% of the native egg yolk original fat and cholesterol has been removed, but replaced with an edible vegetable oil in an amount from 10 to 70% by weight of the refatted egg yolk solids.

2. The product of claim 1 wherein the edible vegetable oil is a vegetable seed oil.

3. The product of claim 1 or 2 which comprises egg yoke solids from which between 50% and 90% of the original fat has been extracted.

4. The product of any of claims 1 to 3 wherein the ratio of polyunsaturates to saturates in the vegetable oil is at least 1.0.

5. The product of claim 4, wherein the ratio is at least 2.

6. The product of any of claims 1 to 5, wherein the vegetable oil comprises corn oil.

7. The product of any of claims 1 to 6, which also comprises, in intimate admixture, at least one flavoring and a coloring agent.

8. The product of claim 7, comprising, in addition, salt as a flavorant.

9. The product of claim 8 which includes at least 0.75% of salt, by weight of the product, as a flavorant.

10. The product of claims 7, 8 or 9 which includes beta-carotene as a coloring agent.

11. The product of any of claims 1 to 10, wherein the total amount of fat is from 35% to 80% by weight of the product.

12. The product of any of claims 1 to 11, which includes a minor amount of at least one edible emulsifier of the water-soluble type.

13. The product of claim 12, wherein the emulsifier comprises polyoxyethylene (20) sorbitan monostearate.

14. The product of claim 12 or 13, wherein the emulsifier comprises glyceryl mono-oleate.

15 An egg product mixture comprising an aqueous slurry of particulate, refatted egg yolk solids as defined in any of claims 1 to 14.

16. A formulated food product having, as an ingredient thereof, particulate, refatted egg yolk solids as defined in any of claims 1 to 14.

17. The product of claim 16, wherein the food product is a mix for a scrambled egg or omelet.

18. The product of claim 16, wherein the food product is a custard mix.

19. The product of claim 16, wherein the food product is an instant breakfast drink.

20. The product of claim 16, wherein the food product is a cake mix.

21. The product of claim 20, wherein the food product is sponge cake mix.

22. The product of claim 20, wherein the food product is pound cake mix.

23. A conveniently packaged egg combination food product for mixture and rehydration to form a consumable, egg product upon cooking, comprising: an easily rehydratable, dry egg material of small particulate size as defined in any of claims 1 to 14, packed in a first moisture-proof, sealed package, and a food of gross particulate size, in microbiologically and organoleptically stabilized from, requiring no further hydration, packed in a second moisture-proof, sealed package, the proportions in each of said packages being compatible to permit their use together in preparing a composition, ready for cooking, by rehydrating the egg material and mixing with the food of gross particulate size.

24. The product of claim 23, wherein the particles of dry egg material have a maximum dimension of less than 2 millimeters.

25. The product of claim 24, wherein the particles of dry egg material have a maximum dimension of less than 1 millimeter.

26. The product of claims 23, 24 or 25, wherein the particles of the gross particulate

food material have a maximum dimension greater than 3 millimeters.

27. The product of claim 26, wherein the particles of the gross particulate food material have a maximum dimension greater than 5 millimeters.

28. The product of any of claims 23 to 27 wherein the food of gross particulate size is a ready-to-eat food selected from simulated fried bacon strips, vegetable components, ham analog, sausage analog, and salads that are usable as components in cooked egg dishes.

29. The product of any of claims 23 to 28, wherein the moisture-proof package is formed of polyethylene film.

30. The product of any of claims 23 to 28, wherein the moisture-proof package is formed of polyvinylidene chloride film.

31. The product of any of claims 23 to 28 wherein the moisture-proof package is formed of a laminate consisting of polyvinylidene film, foil and kraft paper.

32. The product of any of claims 23 to 31 wherein the gross particulate food material is a moist, ready-to-eat food material containing in an acetic acid environment from 0.015% to about 0.3% of an edible fungistat and from 0.0004% to 2% of an edible water-soluble metal chelating agent, said fungistat, chelating agent and acetic acid being evenly distributed throughout the moist, ready-to-eat food material and said food material having a pH less than 5.

33. A conveniently packaged egg combination food product according to any of claims 23 to 32, comprising: a sealed, substantially moisture-proof first package containing an easily rehydratable, refatted, dry egg material of small particulate size as defined in any of claims 1 to 14; and a sealed, substantially moisture-proof second package containing, as an adjunct for the rehydratable egg material, a ready-to-eat food of gross particulate size selected from simulated fried bacon strips, vegetable component, ham analog, sausage analog, and salads that are usable as components in cooked egg dishes, said food of gross particulate size being substantially free of cholesterol and in microbiologically and organoleptically stabilized form reequiring no further hydration prior to consumption; the proportions in each of said packages being compatible to permit their use together in preparing a composition, ready for cooking, by rehydrating the egg material and mixing with the food of gross particulate size.

34. The product of any of claims 23 to 33 wherein the dry egg material and the ready-to-eat food of gross particulate size provide in combination, following rehydration, mixing, and cooking, a cooked product which is substantially free of cholesterol, and wherein the fat component has a ratio of polyunsaturated to saturated fatty acids of at least 1.0.

35. The product of any of claims 23 to 34 wherein the ready-to-eat food of gross particulate size is packed in an amount varying from 0.25 to 2.0 parts by weight for each part by weight of the dry egg material of small particulate size, and the final egg combination has a pH between 6.0 and 8.5.

36. A process for preparing refatted egg yolk solids from dehydrated egg yolk solids from which a portion of the original fat has been removed, comprising: forming an emulsion of the oil-in-water type from a mixture comprising an edible vegetable oil, the partially defatted and dehydrated undenatured egg yolk solids from which at least 50% of the original fat has been removed and water but replaced with an edible vegetable oil in an amount from 10 to 70% by weight of the defatted egg-yolk solids; subjecting the emulsion to a drying process, and recovering substantially dry fatted egg yolk solids.

37. The process of claim 36 wherein the water is present in an amount of at least 40% of the emulsion.

38. The process of claim 36 or 37, wherein the edible vegetable oil is present in an amount between 40 and 230 parts for each 100 parts of fat-extracted egg yolk solids.

39. The process of any of claims 36 to 38 which comprises forming the emulsion from a mixture comprising between 40 and 230 parts of an edible vegetable oil, 100 parts of fat-extracted egg yolk solids, and from 100 to 800 parts of water; and subjecting the emulsion to a rapid drying process.

40. The process of any of claims 36 to 39 wherein the drying process is spray drying.

41. The process of any of claims 36 to 40 wherein at least one flavorant and/or at least one coloring agent are included as components of the original mixture.

42. The process of claim 41 wherein the mixture includes a minor portion of *beta* carotene as a coloring agent.

43. The process of claim 41 or 42 wherein the mixture includes a minor portion of salt as a flavorant.

44 The process of any of claims 36 to 43 wherein the mixture comprises at least one edible emulsifier of the water-soluble type.

45. The process of claim 44 wherein a phosphated monodiglyceride is a component of the original mixture.

46. The process of any of claims 36 to 45 wherein the edible vegetable oil is present in an amount between 80 and 120 parts.

47. The process of any of claims 36 to 46 which comprises: mixing together from 80 to 120 parts of an edible vegetable oil, at least one edible emulsifying agent of the water-soluble type, salt, 100 parts of the fat-extracted yolk solids, and water in sufficient quantity to form at least 40% by weight of the mixture; forming this mixture into an emulsion of the oil-in-water type; pasteurizing the emulsion; spray drying the emulsion under conditions

such that substantially no protein denaturation occurs, and recovering substantially dry, free-flowing, discrete particles of refatted egg yolk solids.

48. The process of any of claims 36 to 47 wherein the edible vegetable oil is high in polyunsaturates, having a polyunsaturated-to-saturate ratio greater than 1.0.

49. The process of any of claims 36 to 48 wherein the vegetable oil is corn oil.

50. The process of any of claims 36 to 49 wherein the water is present in an amount to provide an emulsion containing 30% to 40% total solids.

51. The process of any of claims 36 to 50 wherein the fat-extracted egg yolk solids are yolk solids from which up to 90% of the original fat has been removed.

52. The process of any of claims 36 to 51 wherein the fat-extracted egg yolk solids are substantially free of cholesterol.

53. A particulate, substantially dry egg yolk solids product substantially as hereinbefore described with particular reference to the examples.

54. A conveniently packaged egg combination food product for mixture and rehydration to form a consumable, egg product upon cooking substantially as hereinbefore described with particular reference to the examples.

55. A process for preparing refatted egg yolk solids from egg yolk solids from which a portion of the original fat has been removed substantially as hereinbefore described with particular reference to the examples.

STEVENS, HEWLETT & PERKINS,
Chartered Patent Agents,
5, Quality Court,
Chancery Lane,
London, W.C.2.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1971.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1253271 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

Fig.1.

Fig.2.

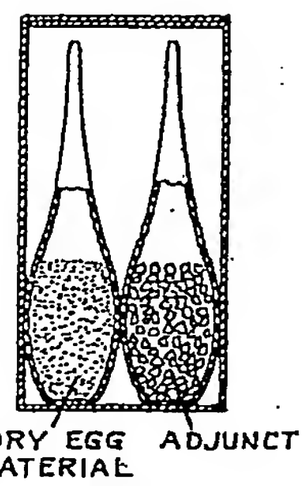

Fig.3

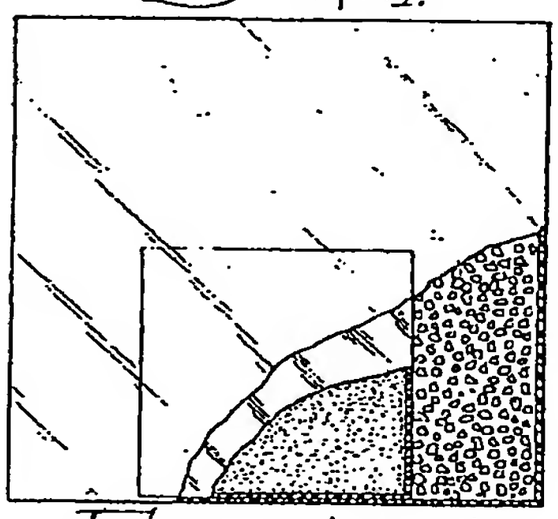

Fig.4.

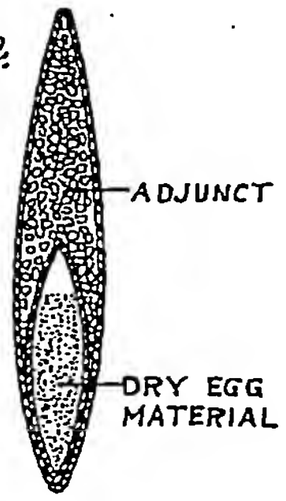

Fig.5.

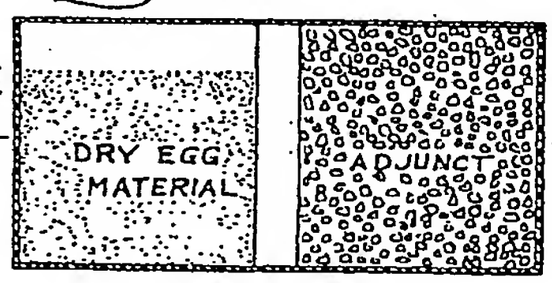

Fig.6.